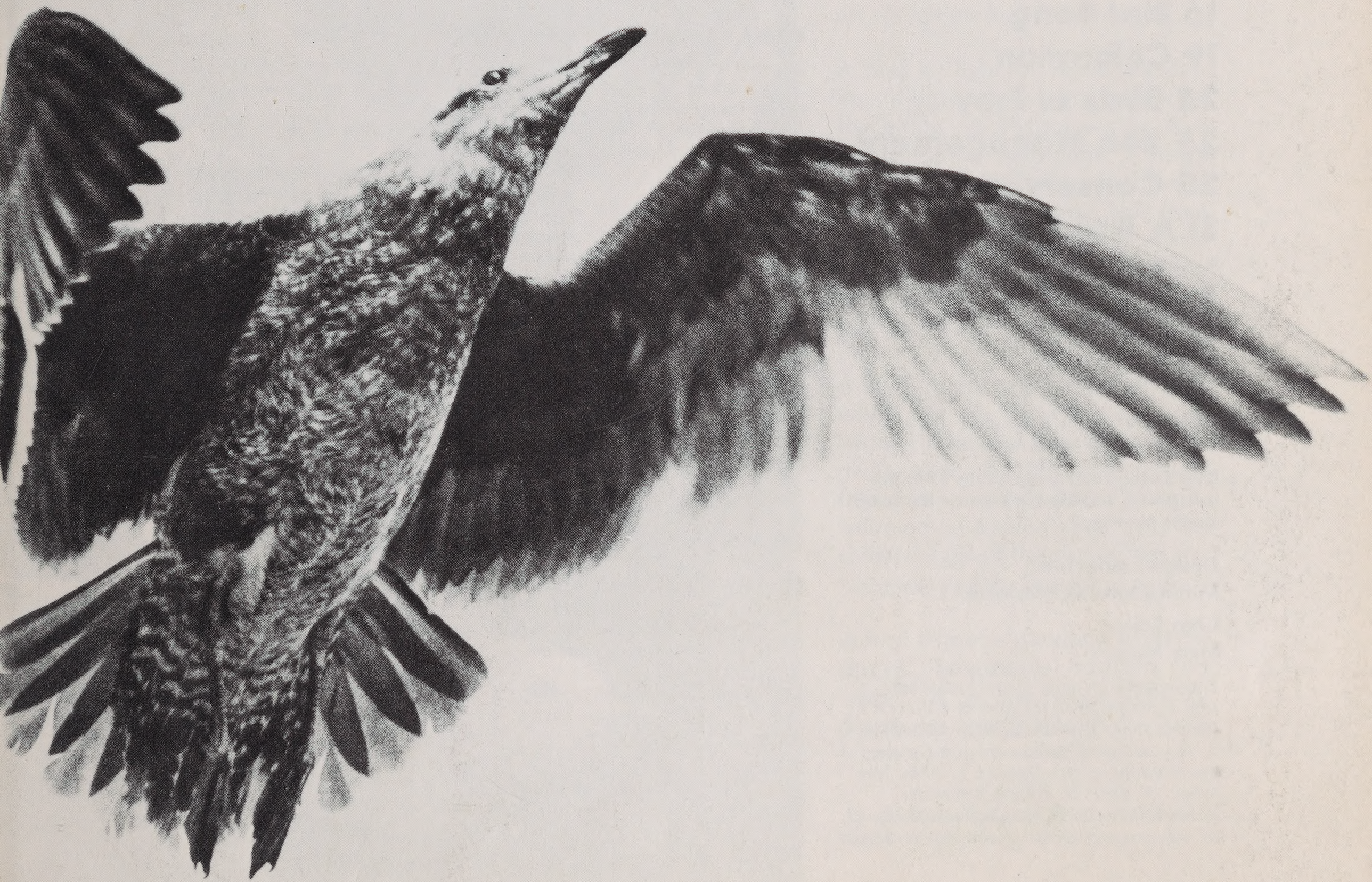
THE ZOO GOER

Birds



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Back Cover: Feathered tapestry at its brilliant best is displayed in a peacock's shimmering plumage.

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A Bird Is. . .

What is a bird? By definition, it is a warm-blooded, feathered vertebrate. By analogy, it is a perfect flying machine. Sentimentally, it is a little feathered friend. Jonathan Livingston Seagull explained that he was ". . . not bone and feather, but the perfect idea of freedom and flight . . . limited by nothing at all." Birds evoke many images.

A bird is flight. It is the wandering albatross, circumnavigating the globe on 11-foot wings. It is the peregrine falcon in a 175-mph power drive. It is the ruby-throated hummingbird, less than an ounce of organized protoplasm, flying 500 miles across the Gulf of Mexico. It is the osprey seizing a fish in a flash of spray.

A bird is an egg—three pounds worth for an ostrich, pea sized for a hummingbird. It is round owl's eggs, nested in a hollow tree, or pointed murre's eggs, spinning on a rocky shelf. It is the spotted eggs of the plover and the tinamou's turquoise china eggs.

A bird is feet—paddling webs on ducks, frogmen's flippers on swans. It is the stout toes of pheasants, scratching in the dust,

Air-curved feathers and lifted wings power this silver gull at take-off.

or the long, slender toes of the jacana, tiptoeing across lily pads. A bird's foot is quail tracks in the snow and sandpiper tracks across the beach.

A bird is voice. It is the wild chorus of loons before a storm. It is the thrush in the last summer daylight, or a chickadee's first, tentative "phoebe" call in February. It is the booming of the emu, the shrieking of the sea eagle, the laugh of the kookaburra, and the courtship scream of the argus pheasant.

A bird is color. It is a scarlet cardinal in the snow or the metallic flash of a hummingbird in the petunias. It is a hyacinth macaw, a strutting peacock, and a flamingo. It is the startling crimson flash of the turaco's wing.

Ever-alert ears provide stereo reception to enhance the hunting skills of this Malay fish owl.

A bird is design. It is the complex structure of a feather. It is an elegantly adapted skeleton with hollow bones trussed like industrial girders. It is lungs that provide efficient air cooling. It is the hawk's eyes with six times the range of the human eye. It is the stereo reception of owls' ears and the soaring wings of vultures.

A bird is vital—an active participant of its environment. It is a spreader of seeds and a pollinator of flowers. It is a swan clearing a pond of weeds, and a duck carrying pond weeds from one lake to another on its feet. It is an eater of insects and a controller of mice. It is the kookaburra that eats snakes in an Australian garden or a grouse being eaten by a fox in the Arctic winter. Once it was a dodo, in whose gizzard seeds were abraded until the seedling could split the shell, but that was long ago.

A bird is excitement. It is the gleam of a bald eagle high above, head and tail brilliant white in the sun. It is the flight of Canada geese calling each other as they make their landing. It is the muted glory of the argus pheasant's display. It is the wild courtship ballet of the cranes and the graceful, neck-twining courtship of the swans. It is a newly hatched kiwi.

A bird is competence. It is the emperor penguin cradling his egg

on his feet for two months of the Antarctic night. It is migratory warblers, voices in the night as they travel south. It is a flock of juncos, nestled safely in a snow-covered bush. It is sand grouse, soaking up water in their feathers to carry to their brood.

A bird is myth and legend. It is the eagle of Jove and the owl of Athena, Juno's peacock and Odin's raven. Leda had a swan and so did Lohengrin. The Egyptians had the god Thoth with the head of an ibis and Horus with the head of a hawk. Prehistoric man carved an owl in his cave; American Indians worshipped the thunderbird. Birds are deep in our past.

A bird is a symbol. There were eagles on the Roman standard and hawks in heraldry. Hawks and doves fly down the halls of the Capitol.

We are "proud as peacocks" and "happy as larks" and "welcome as the robins in spring." A wild goose embodies both an act of futility and an untamed spirit.

A bird is a long, lonely flight into the dark. It is a vanished flock of passenger pigeons and Carolina parakeets. But it is sometimes a flight into a new dawn. It is trumpeter swans again on an Idaho lake and a family of nene geese on Haleakela. It is 105 whooping cranes where there were but 14. It is hope for the future if we learn to understand and respect the present. □

Graceful grazers of aquatic pastures, the Zoo's black swans search their pond for edible grasses.

by Sally Tongren
FONZ House Guide

Migration

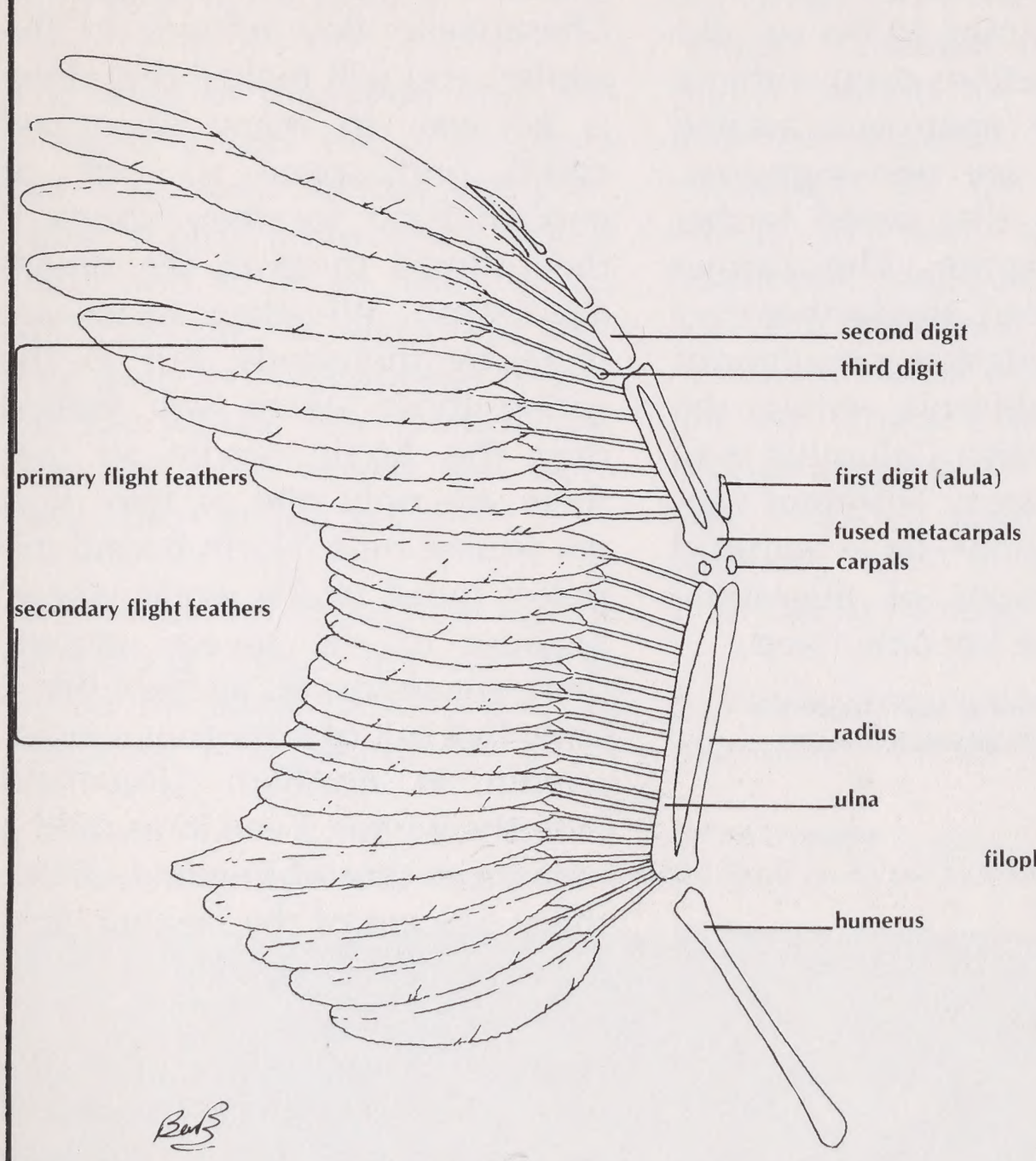
. . . said the second swallow, "First, we feel it stirring within us, a sweet unrest; then back come the recollections, one by one. . . ." "Ah, yes, the call of the South, the South!" twittered the other two dreamily. . . . " And do you think," said the first swallow, "that the other call is not for us too, in its due season? The call of lush meadowgrass, wet orchards, warm insect-haunted ponds . . . and all the farm buildings clustering round the House of the perfect Eaves?"

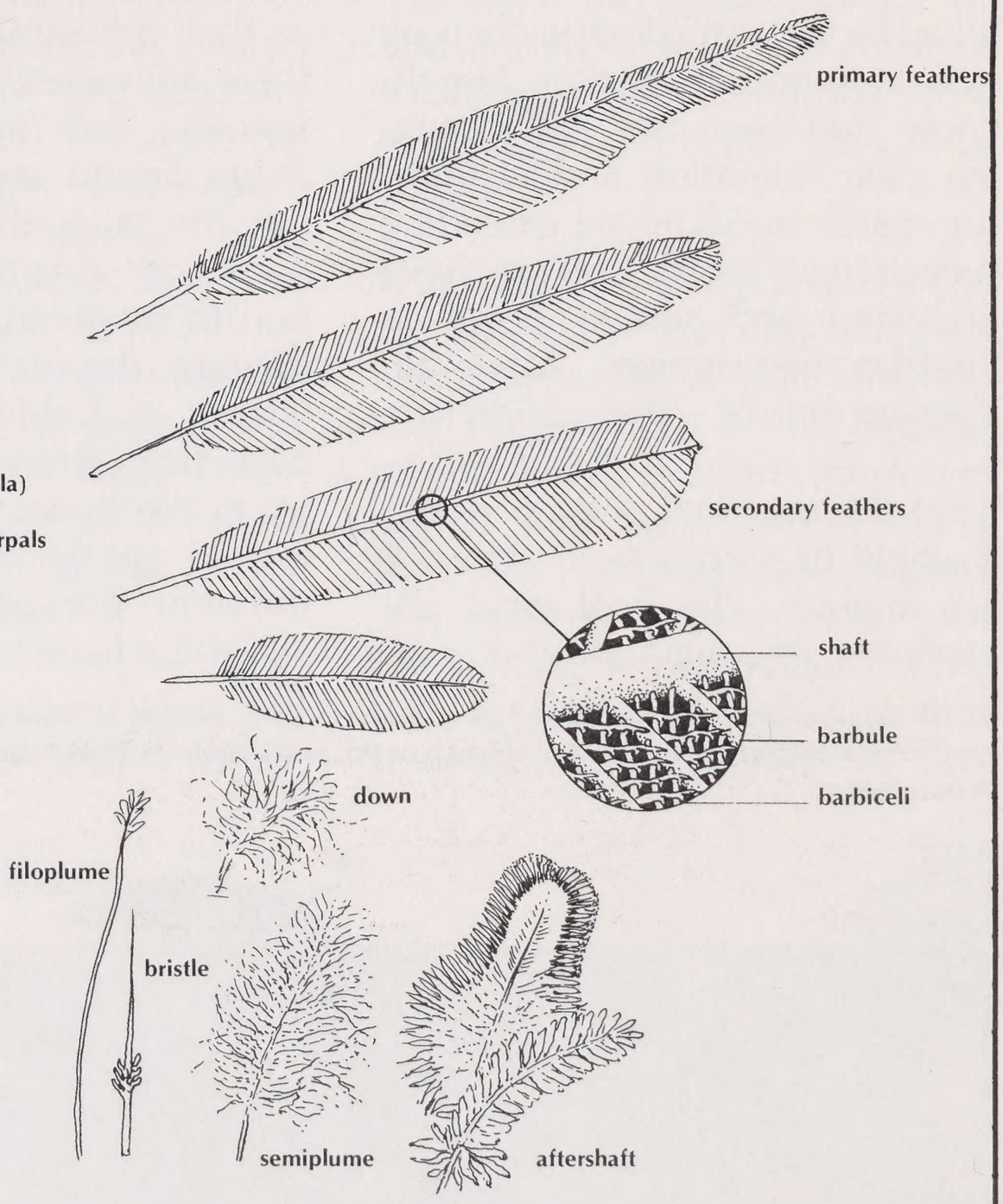
The Wind in the Willows

by Kenneth Grahame

Migration has always stirred man's imagination. We feel that if migratory birds did talk, they would sound like the swallows, expressing a longing that pulled them toward remembered scenes. And, for all the study which has been devoted to it, there is still much about migration that we do not fully understand.

Migrating mallards blacken the sky as "internal clocks" send them commuting in mass from winter to summer homes.





Feathers distinguish birds, as a class, from other vertebrates. Light in weight, yet surprisingly strong, they insulate, waterproof, and streamline a bird as well as enable flight. A typical feather consists of a strong central shaft off which emerge a series of parallel barbs. The barbs, in turn, branch into tiny parallel barbules which carry either microscopic hooks or flanges. These lock the barbs to form a tight, flexible surface. Down feathers, found on many baby birds and some adults, have no central shaft or barbules, but are unsurpassed as insulation.

Feathers are adapted for special purposes. Flightless birds, such as the rhea and emu, lack barbules, so their feathers look hairy, yet shed water and provide warmth. Many birds have ornamental plumes that play a part in courtship or as recognition marks. Others, like the kiwi and frogmouth, have feather bristles around the mouth that transmit touch. The owl and ostrich have feather eyelashes.

The outer, or primary, feathers of the wing do most of the work in flight. Without these, the bird cannot fly. To glide and soar, a bird makes use of moving air and the excellent aerodynamic design of the wing for a type of flight that uses very little energy. All birds glide at times, but sea birds such as the albatross may spend most of their lives soaring over the sea, coming to land only to breed.

The flapping flight of robins or crows uses more energy but permits fast changes in direction. Power is provided by the forward and down stroke of the wing, driven by the large flight muscles of the breast. On the return stroke, the wing is half folded, and the primary feathers open like venetian blind slats to reduce air resistance.

We do not know why birds started to migrate. Undoubtedly it had to do with climatic changes over long periods of time. We do know that birds are still changing their migration and distribution patterns. Some are extending their ranges north; others have appeared and settled down in another hemisphere. After all, they are mobile—they can fly!

From the practical point of view, it would be surprising if birds did not migrate. The ecological advantages of migration far outweigh the dangers of the long trips. Birds migrate because it is to their advantage to do so. But there are variations even within a species. Fox sparrows around Puget Sound are non-migratory, but the races that breed farther north do migrate. The farther north they breed, the farther they migrate: the Alaskan populations winter in California, while the birds from British Columbia winter in Washington. Different ecological conditions have induced different patterns of migration, and these have become fixed.

A rich array of plumage sets apart the Mandarin duck. Native to the Far East, these distinctive waterfowl are losing their forest, pond, and stream habitat to modern forestry management.

What are the advantages of migration? If you visit one of the Chesapeake Bay refuges in the winter, you will realize that there is no way so many waterfowl could find space to nest or enough food for their young if they stayed there in the breeding season. Whistling swans are there by thousands, but in the spring those swans will spread over the Arctic tundra so that there are only one or two pairs per square mile. North-bound migrants move into a world where, because of the severe winters, there are almost no resident birds. Only five out of sixty-four species remain in northern Greenland over the winter. Even in as mild a climate as that of England, about thirty percent of the nesting birds are migrants.

However bleak the winter climate, food and nest sites abound in the northern summer. The long days allow maximum time for the parents to forage for their growing young. Because the nesting period is short, only a few weeks in the high Arctic, and the population dramatically increased, there are a tremendous number of young birds present for a short time. Predators, including migratory hawks and skuas, may grow fat during this period, but they do not seriously affect the bird population. In fact, predation in the

Arctic is much less severe than it is for birds in the tropics.

The whys of migration are clear when one sees the advantages, but the hows remain complex. How do birds know when to start north and when to leave in the fall? How do the swans find their way from the Chesapeake Bay to the Mackenzie Bay Delta? How does the blue-winged teal navigate from Canada to Chile?

Generalization about migration is dangerous, since not all birds follow the same pattern. Usually migration is a part of the bird's breeding cycle and is governed by an internal mechanism, or "clock." Changes in day length trigger activity of the pituitary and thyroid glands. This starts development of the sex organs, which in turn secrete other hormones. Many birds molt into breeding plumage, and all accumulate a layer of fat as fuel for the trip. There is a general restlessness among the birds. Favorable weather, such as a warm, southerly wind in spring, is the final cue to fly north.

A similar sequence governs fall migration. The sex organs shrink, there is often a post-nuptial molt, and as the days grow shorter, the birds fatten for their trip. Again, it is often weather conditions that send them south, this time on a north wind.

What about birds that winter in the tropics where day length is about the same all year, or those that winter south of the equator where the days grow shorter in March and April? What starts their body changes and triggers migration? No one knows for certain. There may be cues in the local environment that we do not understand, or it may be that

Whistling swans find winter haven and grain-filled fields along the Eastern Shore of Maryland.

their internal "clock" was set the preceding fall to go off in the spring. Different populations of the same species start north at different times, depending on the arrival of spring at their destination. Tropical birds have their own patterns of movement, usually in response to rainfall and availability of food. For instance, Australian grey teal move rapidly into flooded areas, taking advantage of a scarce and temporary resource in order to nest and raise their young. Their breeding cycle and migrations are governed by rain, regardless of season.

Spring migration usually proceeds at a steady pace. Spring storms may delay the traveling flocks, but they pick up speed once the weather is right. Certain conditions, such as open water in the case of waterfowl, are required before it is safe to arrive on the breeding grounds. Canada geese follow closely the advance of the 32-degree isotherm, which assures open ponds and rivers. Other species seem to wait for warm weather and then make a fast through trip. Rarely is the arrival of migrating birds as regular as the swallows at Capistrano, but it usually falls within a predictable few days.

In fall, migration is more leisurely. Young birds of many species wander extensively. Adult ducks molt all their flight feathers at one time and take molt migrations to sheltered marshes or bays where they can spend the three- to four-week flightless period in safety. Meanwhile, the young of the year wander far afield. Shelducks from all around northern Europe migrate to the island of Heligoland in the Baltic at this time, returning after the molt to their native beaches.

Some birds start south almost before the summer has begun. Sandpipers, possibly those that were unsuccessful in nesting, appear in New England in July still in breeding plumage. They may feed along the beaches for several months. Male ruby-throated hummingbirds depart as early as July, leaving the females to raise the broods. Many warblers start south while the weather is still good and the food abundant. Blue-winged teal go south in September, but mallards may stay until snow falls, or even through the winter if there is open water. Many water birds only move from fresh to salt water. Each species has its own pattern, which is part of its breeding cycle.

There are many different ways of migrating. Waterfowl travel by day or night. They must have water to land, and they probably travel from one good stopping place to the next. These may become traditional stops, since waterfowl travel in family groups or flocks of mixed ages and the young birds are able to learn the routes. Many of the small songbirds travel at night, giving them a chance to feed during the day. Hawks usually travel by day, as do storks and cranes. All these birds ride rising air currents to help them along. They avoid traveling over large bodies of water where few thermals exist.

Birds may travel in flocks or solo. Flocks offer protection from predators and the advantage, sometimes, of experienced travelers for guidance. Flocks may be all adult or all immature birds; they may be all males or mixed females and young or all ages and sexes. There may be only one species in a flock or several. Geese and swans travel in family groups or flocks made up of several families. The familiar V-shape of these flocks is an energy saver; each bird slightly reduces the wind resistance for the bird behind. Birds sometimes change places in the formation.

Birds may follow one route going south and another coming north. The golden plover flies south directly across the ocean from Newfoundland to a landfall in

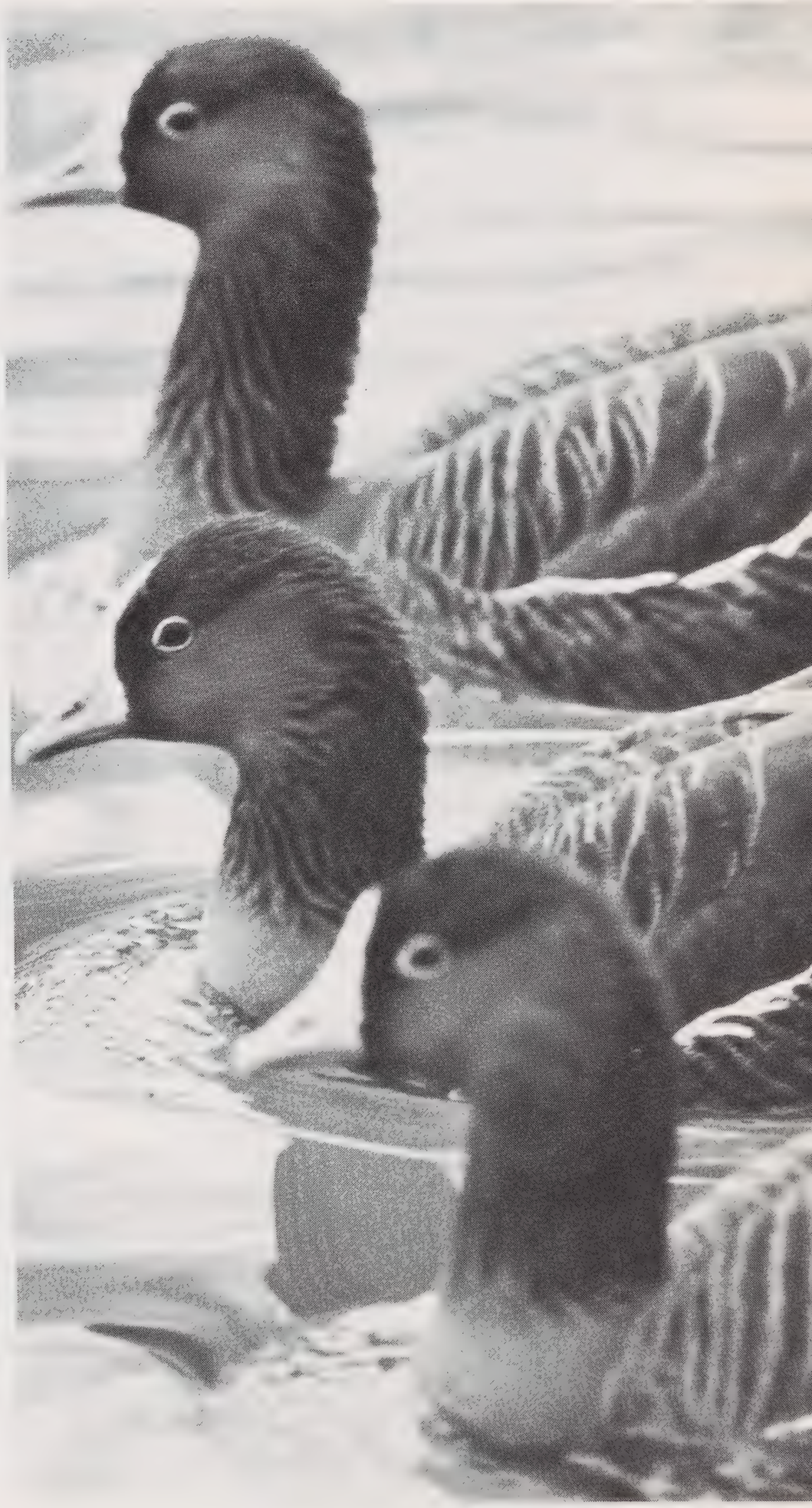
South America on its way to Argentina. It returns by way of Panama, across the Gulf of Mexico, and up the Mississippi. In the fall, Newfoundland has plenty of food to fatten a bird for a long trip, but in April it is still bound in ice and fog. The Arctic tern migrates to the Antarctic down the coast of Africa from its Canadian nesting grounds, but returns up the South American coast. This allows it to take advantage of favorable wind patterns.

Distances traveled, speeds, and heights vary. Lesser snow geese wintering on the Gulf of Mexico may cover the 1,700 miles from Canada to Louisiana, nonstop, in 60 hours. Ducks may travel down the Mississippi flyway in massive flocks known as a "grand passage." One group left Saskatchewan on October 23 and 24 and arrived in Louisiana on October 24 and 25. This is a trip of about 2,400 miles at about 48 mph. Most birds probably average around 35 mph. Most fly fairly low, 5,000 feet or less. Some will climb higher to get above clouds. The record is 21,000 feet.

How do birds find their way? Experiments indicate that birds can navigate by the sun and stars. A captive bird in the restless state that precedes migration will hop around its cage. If it can see the sky, most of its movements will be in a fixed direction, north in spring and south in fall. If it cannot see the sky, its movements are random. Feeding flocks can be seen taking short flights, almost always in the direction of their destination. Experiments in planetariums show that some birds have an innate orientation to star patterns. Many birds will not fly in overcast weather, although some will gain altitude until they are above the clouds. Others, including ducks, seem to be able to take their direction from the wind. Wave patterns may give directional clues to oversea travelers, and probably some birds use landmarks—rivers, mountain ranges, clouds that form over islands. Probably most species use a combination of these methods.

The more we learn about migration, the more complex it becomes. The next time you see a tiny hummingbird buzzing in a petunia bed, consider that it can fly the Gulf of Mexico—nonstop. It's food for thought. □

by Sally Tongren
FONZ House Guide



All in a line, these lesser white-fronted geese swim Zoo waters in search of aquatic plant food.

Courtship

The Zoo's male wattled curassow bends his long neck backward and rests his head on his shoulders. He lifts his stiff back tail, revealing snowy white feathers. In this awkward pose he circles around the female again and again. Sometimes he pauses to pick up small pebbles or other objects and holds them briefly in his bill.

This curious performance of the wattled curassow is called a courtship display. It is only one of thousands of elaborate courtship rituals used by birds. It may seem puzzling at first that birds should have evolved so many complex courtship behaviors. After all, comparable displays are seldom found in either mammals or reptiles.

Part of the explanation is that birds are highly visually oriented. The evolution of flight required the evolution of keen eyesight. Unlike most reptiles and mammals, birds can see colors. Most of their courtship displays use brightly colored feather patterns, raised crest feathers, or unusual postures by the male. All such elements appeal to the sense of sight.

The fanning display of an Indian peacock is just one of many colorful courtship rituals used by birds to attract the attention of potential mates.

The wattled curassow, for instance, has lobes or "wattles" of bright red-orange flesh above and below his bill. When he rests his head on his shoulders, the bright orange of the wattles contrasts sharply with his black body plumage. Lifting his tail to reveal the white features also creates a strong visual contrast.

Charles Darwin was the first scientist who tried to explain the great variety of bird courtship displays. He believed that courtship displays evolved gradually over thousands if not millions of years. If a male performed a simple courtship display and was able to attract and mate with more females than males that did not display, he theorized, then the displaying male would leave more descendants in the next generation. These descendants would presumably also display, and so the display would gradually spread through the entire population. Similarly, the display might later become more and more elaborate. Also, the males might evolve feather colors, crests, or other adornments that would serve to improve the display.

Most scientists accept Darwin's principle of sexual selection. But in light of our modern knowledge of genetics, we can add several points that did not occur to Darwin. First of all, Darwin never really explained why the female should choose a male that displays elaborately over a male whose display is more simple.

Scientists now believe that, in the long run, females choose the fittest partners. In pairing with a highly fit male, a female ensures that her offspring will be fit. Thus she guarantees that her own genes are perpetuated in future generations. A male's courtship display may provide females with a great deal of information about his overall fitness.

For instance, the male wattled curassow must circle the female repeatedly before she will mate. A weak bird may give up before the female responds. Courtship involves even more strenuous performances in many other species. In addition, the very brilliance and elaborateness of the male's plumage can provide an indication of his fitness. Just consider how much of a peacock's food energy must be diverted for him to grow and maintain such long and intricately colored plumes. Yet his plumes are useless except in courtship.

Courting cranes will "dance" by hopping on one foot and then the other as part of their mating game.

Neck-bending, circling, and fanning white tail feathers are all part of the carefully orchestrated courtship display used by the Zoo's wattled curassow.

All courtship displays, from the simplest to the most spectacular, play another important role that did not occur to Darwin. Courtship keeps species separate and prevents their interbreeding. Thus, a female wattled curassow is genetically programmed to respond only to the display of a male wattled curassow and not to the display of a related species.

A male's coloration can signal his species. So, in courtship the male will often prominently display his markings as his species' unique badge. The wattled curassow and some of its close relatives provide a particularly striking illustration of this.

Inhabiting the rain forests of west-central South America, the wattled curassow occasionally encounters members of four other closely related species of curassow. Yet the species apparently do not interbreed. Probably the coloration of the males prevents it.

The distinguishing marks of many birds are far more extensive than those of the curassows. Most male pheasants, for example, have a brilliantly colored and distinctive "uniform." Female pheasants are usually dull brown with few distinguishing marks. The typical male pheasant is probably unable to distinguish a female of his own species from a female of a closely related species. Interbreeding is prevented because the distinctive males are easily recognized by the females.

The Zoo's courting golden pheasant cock displays all of his multicolored plumage. First he stands at an oblique angle to the hen, then expands his orange and brown neck feathers to form a "ruff" so wide it conceals most of his head. He tilts his body toward the female and fans out the blue and black feathers of his midback, the golden feathers of his rump, and his long, mottled tail plumes. The cock holds his pose only briefly. Then he circles around the female, chortling excitedly. This circling may continue for an hour or more. From time to time, the male stops circling and displays his plumage again. At each stop, the male catches the female's attention with a cat-like hiss.

Perhaps the most spectacular pheasant courtship is that of the great argus pheasant, another species on exhibit at the Zoo. In its natural habitat, each adult male argus pheasant has his own

displaying ground on a level spot in the forest. This display court, or "arena," is eight to ten yards in diameter, and the resident male carefully clears it of weeds and debris. Usually several display courts are found clustered in one area, fifty to one hundred yards apart. The sites may be used for several generations. The naturalist William Beebe wrote of a display court in Borneo: "An old Dyak chief led me to this arena and told me that his father had trapped many argus in it, and no one knew when there was not an arena there."

The male maintains his court for at least six months of the year. While there, he begins calling at dusk every day and continues through the night. His "how-ow" call can carry over a mile and lures females. When a female arrives at the court, the male stalks around her with his neck strained forward. His feet make a tapping sound on the ground. Next he spreads his wings to form a wide circle around his bald, blue head. He holds this pose briefly, then jumps suddenly, vibrating his wings and long tail plumes. Both his wing and tail plumes are covered with silvery spots, so shaded that they appear to be three-dimensional beads. Because of these markings, this species has been named for Argus, the many-eyed monster of Greek mythology.

Each phase of a bird's colorful courtship—whether it be the foot-tapping of argus pheasants or the circling techniques of wattled curassows—thus forges a link in the chain of behavior designed for just one reason—the propagation of species. □

by Austin Hughes

The Zoo's great argus pheasant lives up to its name by performing perhaps the greatest of all mating rituals that combines calls, foot tapping, and fanned, vibrating wings. The rituals are performed in special "arenas" in the forest.

Bird Song

Sure sign of spring, a robin readies a worm meal for its hungry young. The spotted breasts of the juveniles indicate their kinship to other thrushes.

Spring means bird song. The observers of old assumed that, like human song, bird song expressed love, joy, or some other emotion. Today scientists say birds sing to defend territory.

In spring an adult male robin—to take a typical example—stakes out his personal territory. His "home" may be a half-acre of suburban lawn from which he will chase off other trespassing males. Cock robin advertises his presence and his ownership of the territory by singing from a conspicuous perch within. Also, if a male does not yet have a mate, his song can attract passing females to his territory. Staking out a claim and protecting it are important because food for the young will have to be found within that territory.

Songbirds are found in only one order of birds—the passerines or perching birds—but this order contains three-fifths of all bird species. Passerines include most of our familiar native birds, such as the robin, cardinal, mockingbird, and song sparrow. The Zoo's Bird House displays exotic songbirds from all parts of the world, such as the Napoleon weaver, the yellow-breasted starling, and the vermillion cardinal.

Birds make other vocal sounds besides song. Walk through a wooded area on a summer after-

noon, and you will hear another bird sound—alarm calls. As you proceed, your arrival is announced by short, explosive chirps. Not only songbirds give alarm calls. The howling alarm calls of seagulls are familiar to every seaside stroller.

Still other bird sounds are used. A mother quail or pheasant uses a special call to point out food to her chicks. During courtship, a female cowbird sounds a specific note when she is ready to copulate. Baby birds of many species beg for food with loud cheeps.

Since birds use sound to communicate, it is not surprising that scientists have studied the ways bird sounds resemble human language. A human child must learn a language in order to communicate with other humans. Do birds also have to learn their songs and other calls?

A simple experiment can shed light on this question. A scientist can take an egg from a song sparrow nest, for instance, hatch the egg in an incubator, and hand-raise the bird in complete isolation from other song sparrows. Such a song sparrow can still give the typical alarm calls of the species. But if the bird is a male, he will never be able to sing the song sparrow's typical song. When he matures, he will produce various erratic whistles but nothing like the song sparrow's distinctive song. So we have found that some bird sounds are innate and some must be learned.

An experienced bird-watcher from the east coast visiting the midwest for the first time may find that many songbirds sound slightly different from those at home. Scientists confirm that there are local dialects. A regional dialect may help a returning migrant bird recognize that he is nearing home.

Scientists have also found that each bird's song is unique. All song sparrows sound like song sparrows—to ornithologists and presumably to each other. But each song is subtly individualized and so like no other. Male birds may use these differences to recognize neighboring males as individuals. The human ear usually cannot detect such differences, but they show up clearly in spectograms—"pictures" of bird song produced by a sonograph machine.

Birds produce vocal sounds differently than mammals. A mammal has vocal cords in the larynx or upper part of the throat. A bird's larynx has no vocal cords. Instead, sound is produced by the within the bird's chest where the two bronchial passages unite to form the windpipe.

Since song helps birds recognize members of their own species, it is not surprising that each of the more than 500 different songbirds

Songbirds, like the red-billed blue magpie, sound off to defend territory, signal alarm, and attract mates. Magpies can also "talk" by imitating human voices.

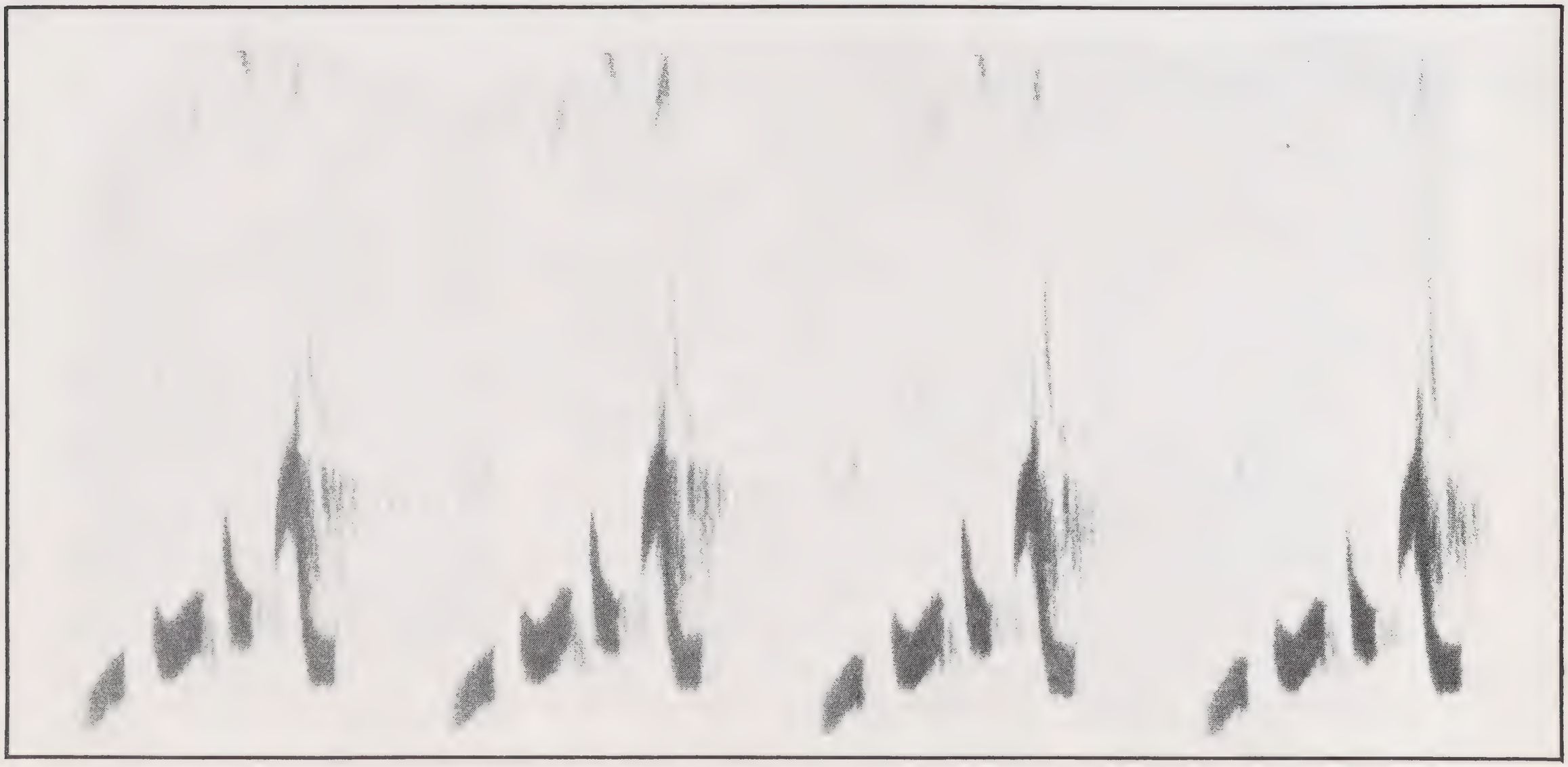
has a distinctive song. Some songs sound harsh and unmusical to human ears. The beautiful golden-breasted starling sounds as harsh and grating as his drab cousin, the common starling. Naturalists say the "best" singers—those whose songs sound the most musical to our ears—are usually drab birds. The grayish mockingbird—frequently called the world's "best" singer—comes immediately to mind.

The National Zoo's Dr. Eugene S. Morton has conducted research to learn why different species have evolved diverse songs. Working in Panama, he found that forest birds tended to have relatively low-pitched songs, while grassland birds had a wider range of pitch. The forest vegetation, he discovered, quickly blocks out high-pitched sounds. Thus, the forest birds use a song that travels farthest in their particular habitat. The grassland birds can use higher frequencies since nothing in their habitat interferes with these frequencies.

Harbinger of spring and delight to human ears, bird song is, in fact, a vital language used by feathered creatures to stake out territory, attract females, signal alarm, and much, much more. □

by Austin Hughes

Spectograms that graph bird sound help the Zoo's Dr. Eugene Morton learn why different species sing different songs.



Coloration

Birds as a class are the most colorful of the vertebrates. Perhaps only an animal that can quickly fly from danger can afford to be so conspicuous. Taken as a group, the Psittaciformes—parrots, macaws, cockatoos, lorys, and parakeets—are among the gaudiest birds. Kept as cage birds for centuries, they tame readily, and many can be taught to talk. Sad to say, parrots have no idea what they are saying. They simply mimic. In the wild they communicate with loud, rather harsh cries that carry through the thick treetops where many of these birds live.

The Psittaciformes are widespread through the tropics: Central and South America, Africa, Southeast Asia, and the Malay-Australian region. They are large headed, short necked, and usually brightly colored. They have strong hooked bills and a prominent hump or cere on top of the bill through which the nostrils open. All have four toes, two pointing forward and two back, giving them a powerful grip. Psittacines use these powerful feet and often their bills to climb through the branches. They often pick up food in one foot and eat

The gaudy scarlet macaw belongs to a colorful class of birds called Psittaciformes that includes parrots, cockatoos, and parakeets.

Zoo-installed wire mesh provides support for stick nests built by the resident colony of scarlet ibis.

it as we eat a sandwich. They fly strongly, but not for long distances. Their broad rounded wings are well suited to maneuver through close-placed branches in the forest. Most psittacines nest in holes.

Usually male and female psittacines have the same coloring, but the male and female of one species, the eclectus, are so different that they were long considered to be two different species. The male eclectus is green with crimson wing linings, and the female is crimson with blue markings.

Australia and New Zealand boast a number of atypical parrots—nocturnal forms, ground-nesting forms, and the flightless kakapo in New Zealand. Many of these live in grassland areas and have predominently brown and olive green plumage.

How can brilliantly colored birds survive without the marvelous protective coloring of so many other species? If you study the woodcock or the hen pheasants in the Bird House, it is clear that these birds are well hidden when they hunt for worms in the dead leaves or nest on the ground. Birds of open fields and shores, like sparrows and sandpipers, need protective, or cryptic, coloring for concealment. But parrots and other brilliant tropical birds are actually far less conspicuous than one might think. In the intense light, flashing green foliage, and colorful flowers of the high tree tops, the greens, reds, and blues blend rather than stand out. Flashes of color, such as red wing patches, help them keep in touch with each other among the thick leaves. Even among birds that are cryptically colored, such as shore birds, there are often white tail feathers and wing patches that appear to serve as signals to the other members of the flock. Although color seems to be related to the bird's habitat and serve as protection, there is much still to be learned about this. There appears to be a connection between a warm, humid climate and the intensity of color. Whether this is related to humidi-

ty, diet, or some other factor is not known.

A common misconception is that male and female birds are different in color. In fact, this is true for only about half of all birds. It is generally true of birds like pheasants that nest in the open and in species like cardinals where the female alone incubates the eggs. The male's brilliant color helps advertise his ownership of a territory and attract a mate. A great many tropical birds and most birds that nest in colonies, like flamingos and ibis, have both sexes colored the same. What the advantages of this may be are not entirely clear. Certainly birds like the psittacines and toucans that usually nest in holes do not need protective coloring on the nest, and birds that nest in colonies are protected by the large number of birds present. But these are only partial answers to a complex question.

What is the source of color in birds? One visitor seriously asked if the Zoo had painted the lorikeets! Looking at the wonderful colors and patterns, it is hard to believe that color happens naturally. Feather color comes from several different pigments as well as from the structure of the feather itself.

White feathers are unpigmented, but two groups of pigments are responsible for many of the other feather colors. Melanins give black, brown, and dull yellow colors, while carotenoids cause most of the reds, oranges, and yellows. Other colors are caused not by pigments, but by the structure of the feather. Blues, most greens and violets, and all the iridescent colors are in this group. Blues result from a cellular structure in the feather that breaks up light so that only blue is reflected. If these cells also contain red or yellow pigment, the feathers will be violet or green. A few birds have a true green pigment; the turaco is one such bird.

The striking iridescent colors of hummingbirds, peacocks, and even grackles are caused by combinations of twisted, flattened barbules in the feather and an extremely complex cellular structure. Different colors are reflected as the light strikes from different angles.

A mature feather is a finished structure, but color changes may take place as the result of external factors. The cardinal starts the fall with greyish tips on the feathers. These wear away over the winter, revealing his full crimson beauty by spring. House sparrows have a speckled neck band in the fall, but the light tips of the feathers wear off; by spring his bib is solid black. Melanin seems to result in a stronger structure than unpigmented feathers; most white birds have black wing tips, since these feathers receive the greatest stress.

Feathers may fade in sunlight or be stained by iron in the water. Sometimes the oil that the bird applies in preening may affect the color as it does the white tail feathers of hornbills. If the bird's diet is deficient in some element, the feathers appearing after the next molt may lack color. This is often a problem with captive flamingos and other birds that must have carotenoids to keep them in full color. Foods rich in carotene, which is related to vitamin A, include crustaceans, and algae.

Birds have excellent color vision, and much of their communication and social life are governed by the colors they display. Their color is a source of pleasure for zoogoers, but a vital element in their survival. □

by Sally Tongren
FONZ House Guide

Birds of Prey

In one sense, nearly all birds are birds of prey. Almost every species occasionally captures living prey. A robin catching a worm is a predator, as is a swallow chasing flies on the wing. But when we think of birds of prey, we think of falcons, hawks, and eagles.

Falcons, hawks, and eagles all belong to an order of birds called Falconiformes. Collectively, the species in this order are known as raptors.

There are a number of raptor species at the National Zoo. They may be large, like the imperial eagle, which reaches a weight of over six pounds and has seven-foot wings, or small, like the American kestrel that is not much bigger than a robin.

Yet both of these species are superb hunters. Both have the hooked bills and sharp talons characteristic of birds of prey. Both have the keen eyes needed to spot a rodent scurrying on the ground. But there are differences in hunting techniques between the falcon and the eagle.

It will be three to four years before this immature bald eagle will acquire its emblematic white head and yellow beak. Two bald eagles have been born at the Zoo.

The imperial eagle soars for long periods in search of prey. When it sights suitable prey—a ground squirrel, for example—the eagle plummets to the ground. It grasps the prey in its talons, which are so long and sharp that they kill the prey instantly.

The kestrel, by contrast, rarely soars for long. Its sturdy wings are designed for speed, not for sustained soaring. Typically, it watches for prey from a perch like a telephone pole that provides it a good view. After spotting its prey on the ground, the kestrel can hover motionless in the air—something a bird as large as an eagle cannot do. Like the eagle, the kestrel grasps prey with its claws, but the sharp, short claws are designed to hold prey rather than kill it. The prey is killed with a quick bite at the back of the neck.

A few birds of prey live mostly on carrion. Vultures and the crested caracara are such scavengers.

The secretary bird is another unusual raptor. Its name comes from the long quills on its head, which reminded naturalists of the quill pens kept behind a nineteenth century secretary's ear. Unlike other raptors, it does not swoop down on the prey from the air. It can fly, but seldom does. Instead it strides through the African grassland on long, slender legs which are used to trample its favorite prey, snakes. If a poisonous snake strikes back, the bird will take the blow on its wing feathers where it can do no harm.

Another order of birds contains predators as highly evolved as the raptors. These are the Strigiformes, or owls. Though owls are apparently not closely related to the raptors, they have evolved many similar features. Like raptors, owls have sharp talons and hooked bills. But owls differ from raptors since they are adapted for night hunting, while raptors are day hunters.

Owls have very large eyes, specially designed to make use of very low light levels. Owls can see well enough to find food at less than one one-hundreth of the illumination man would need. Of course, even an owl cannot see when there is no light at all. But then the owl can rely on its uncanny sense of hearing. In absolute darkness, an owl can swoop down on and capture a mouse, guided only by the rustling sounds the mouse makes moving through leaf litter.

The nocturnal mammals that owls eat also have excellent hearing. So owls have evolved the

Hooked bill and sharp talons enable Africa's secretary bird to trample and tear apart its favorite prey—snakes. If a poisonous snake strikes, the bird takes the blow on its feathers where it can do no harm.

ability to fly almost noiselessly. The flight feathers on the wings of most birds are stiff quills. Owls have downy fringes at their wing edges that damper the sound of beating wings.

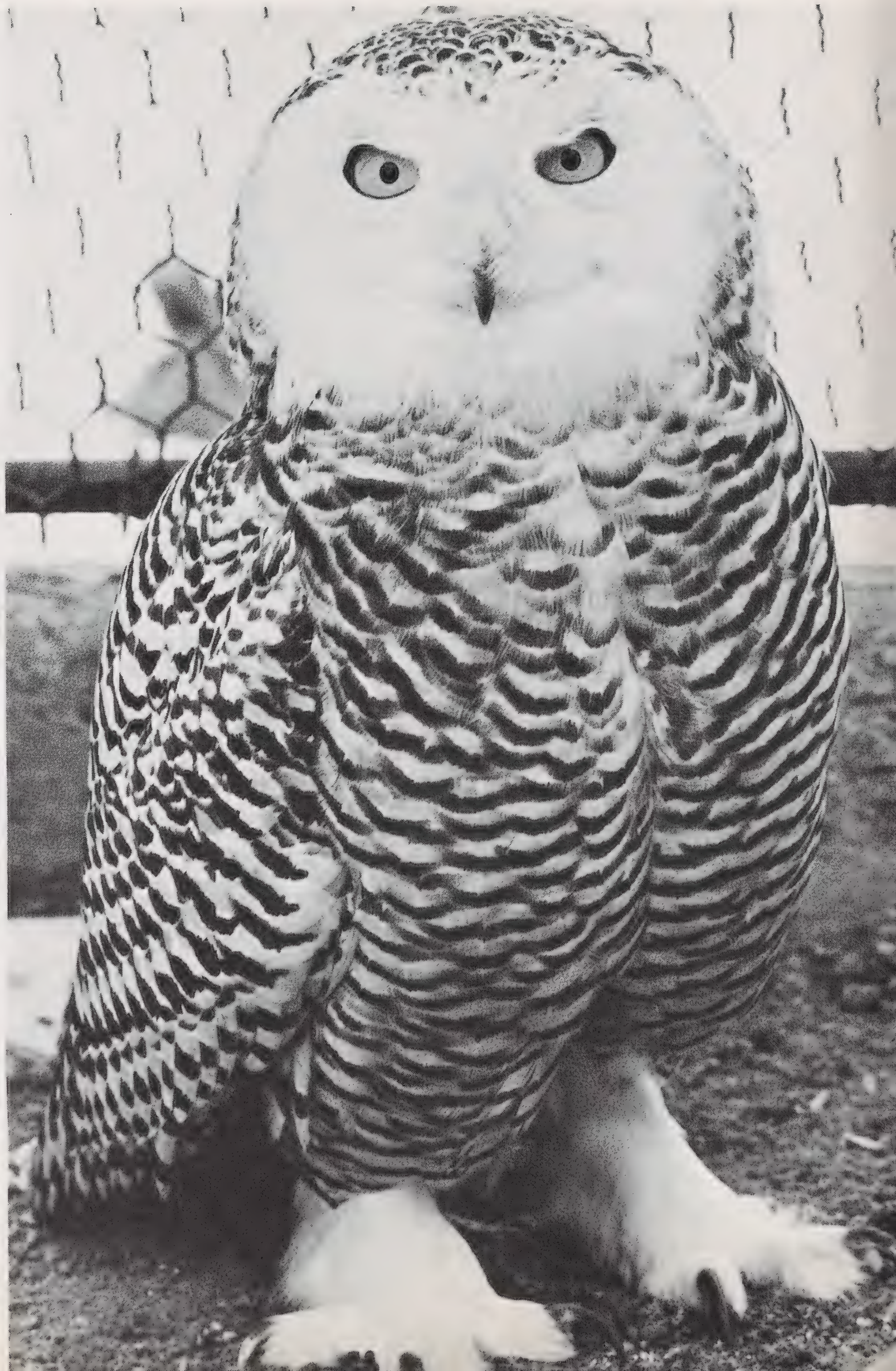
Owls and raptors also eat their

prey differently. A raptor carefully plucks much of the feathers or hair off a dead bird or mammal before eating it. It will usually then tear off pieces of meat with its bill. Owls, on the other hand, usually swallow their prey whole, including bones, feathers, and hair. Later, the owl regurgitates a pellet of the indigestible parts of the prey's carcass. By studing these pellets, scientists know what owls eat.

Predatory birds have not generally been very popular with humans. In the last century, hunters gathered in the hundreds to ambush vast flocks of migratory hawks. Today hawks and other predatory birds have legal protection.

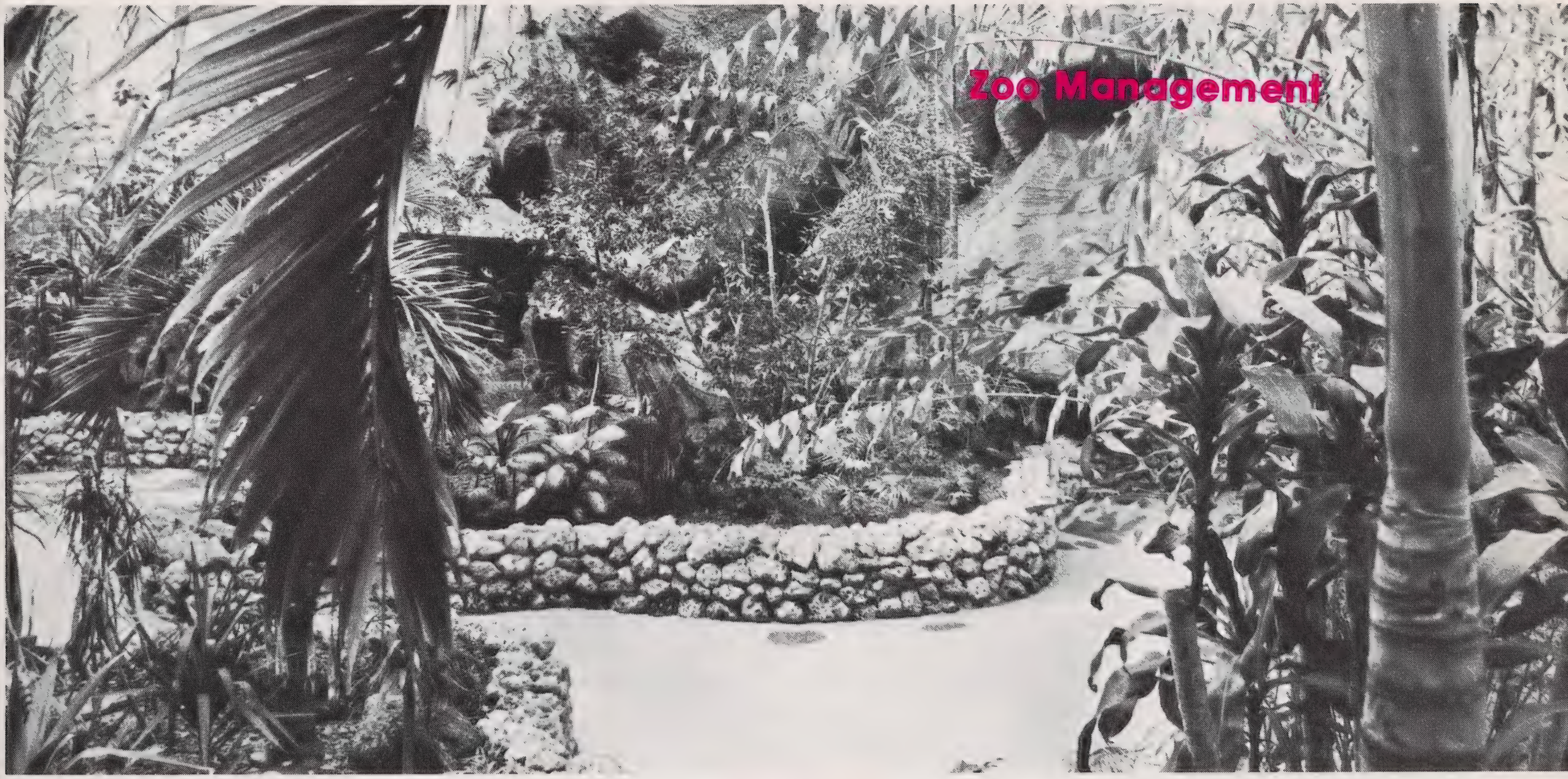
Even so, man still threatens the survival of raptors and owls by using pesticides, which accumulate in the tissues of predatory birds, lowering fertility, and causing thinning of eggshells. Widespread habitat destruction also threatens many such birds. □

by Austin Hughes



The snowy oil of the Arctic matches its tundra-white environment. The "ermine owl" has been known to fly as far south as California and Texas.

Zoo Management



The indoor flight room of the Zoo's Bird House recreates a miniature tropical paradise where dozens of exotic birds live and breed as they would in the wild.

Recently, most zoos have changed their philosophies about collecting and exhibiting animals. In the past, excellence was measured by how many animals and species were exhibited. Today, emphasis is on exhibiting a diversified collection and particularly on propagating each species in captivity.

To do this, we must know a great deal about the species' natural history. How does it live in the wild? Does it live and breed in large flocks, as does the flamingo? What does it eat? Does it have one mate—like most species—or several, like the Zoo's great argus pheasant?

The more zoos know of the natural history of a species, the better the chances of maintaining and breeding them. For example, while a few flamingos can be kept in captivity for years, they will never breed, because it takes the interaction of a large group to initiate breeding.

On the other hand, the mixing of several individuals of a species, such as the turacos, that establishes and maintains a large territory, can be fatal. The dominant male will attempt to drive subordinates from his territory. If they cannot escape, they will in-

Different birds require different exhibits. As for the Zoo's rufous hornbill, careful attention is given to perch diameter, cage size, floor surface, temperature, and light.

evitably die—the more aggressive birds will either attack and kill or prevent their feeding.

Just as important in selecting a species for display is knowing the successes and failures of other zoos in meeting housing, dietary, and health needs.

Space requirements for birds differ between species. The bird's size, its aggressiveness towards cagemates, and its breeding behavior must be considered. Generally, an exhibit should be large enough to allow the birds to move about freely and offer room for escape from other birds and from people. For birds that fly, the ceiling should be high enough to allow the bird to pass over a keeper's head.

"Critical distance"—the closest a person can get to a bird without the bird becoming alarmed—must be considered for each group. Birds at the Zoo are quite accustomed to visitors and will be calm if the visitors stay on the walkways. If an untrained person were to enter an exhibit, the birds would probably become alarmed. This could result in serious, and even fatal, injury to the birds.

In addition to the size of the exhibit, zoos must consider the floor surface, perches, and plants. Each exhibit is a semi-natural habitat, designed for a particular bird or group of birds. Many different habitats, from arid desert to humid, tropical forest, are recreated in the Bird House.

A sandy soil, such as that found in the elf owl exhibit, is necessary for the growth of cactus and other desert plants, but a rich top soil is needed in the tropical room for the tropical plants.

In many exhibits, such as the cockatoos and hornbills, there are no live plants, as these birds will destroy them. In the wild, the damage done is spread over a large area and is not noticeable.

Compare the size of the perches in the hornbill exhibit and those in the toucan exhibits. Proper perching is a necessity, and a bird's feet should reach about two-thirds of the way around a perch.

Temperature, humidity, and amount of light are other elements considered under "housing." Temperature and humidity usually duplicate those found in the species' natural range. Tropical species cannot tolerate extreme cold, just as Arctic species cannot tolerate extreme heat. No bird can cope with sudden, drastic changes in temperature.

Why is humidity important to a bird? Many tropical and subtropical birds respond to high humidity with increased breeding activity. Their survival in the wild depends upon it, as they must produce young in the "rainy season" when there is enough food available to rear the young! In contrast, cold climate birds are susceptible to airborne diseases and fare poorly in humidity.

Changes in light can trigger the development of certain glands. The glands of many species become active in response to an increase in day length, while some species also respond to a decrease. Each indoor exhibit in the Bird House has a separate timer to control the light.

Within the 8,600-plus species of birds found in the world, there exists a great diversity in dietary needs. Through evolution, special feeding organs have evolved to meet individual needs.

Birds of prey, such as eagles, hawks, and owls, have a strong, hooked beak for tearing their food into small pieces.

Large parrots have beaks strong enough to crack nuts, yet possess a tongue that is supple enough to extract the kernel. The flamingos, which feed in the mud of shallow waters, have curved bills lined with hairlike bristles that filter out small plants and animals.

Each bird at the Zoo is fed a diet prepared just for that species. Why do Zoo signs state, "Special Diet - Do Not Feed"? Because like people, birds will fill up on junk food and so spoil a diet.

Nutritional deficiencies often lead to disease, such as those produced by viruses, bacteria, and parasites. The keepers inspect each bird daily to check for any unusual behavior. Illness is often indicated by a loss of appetite. But prevention of disease through good housing, nutrition, and sanitation is of prime concern to zoos. Any new bird arriving at the Zoo is quarantined for 30 days. During this period, constant examinations are made to determine the bird's health.

Once a species has been selected for exhibit, and proper housing, care, and nutrition have been assured, how does the Zoo get the birds? This is most often done through communication between zoos. Periodicals are circulated, listing breeding successes, surplus birds, and bird needs.

To supplement and improve this procedure, the International Species Inventory Systems has been established to computerize inventories at one central location. Not only is inventory data computerized, but also the animal's health and ancestry records.

Once the needed species has been located, there are local, national, and international laws to meet. Many permits and documents are needed to bring a bird into the United States from a foreign country. Upon arrival, every bird must spend 30 days at an official U.S. Department of Agriculture quarantine center.

Even though the procedures to acquire a bird are stringent, they exist to insure the continued survival of all wildlife! □

by Charles Pickett
Curator of Birds

Conservation

Not until the flightless dodo was massacred by 17th Century sailors for food did anyone think about preserving birds. Even since then, man has killed off the passenger pigeon, Carolina parakeet, and ivory-billed woodpecker. Other native American species, such as the whooping crane and California condor, are on the verge of extinction!

Of course, birds have evolved and have become extinct for millions of years because of changes in climate and habitat. But only recently has man become directly involved.

Habitat destruction, pollution, and indiscriminate use of pesticides are just a few ways that mankind has contributed to the decline of wildlife.

If the world population reaches seven billion by the year 2000, as is expected, underdeveloped countries will have to launch new technologies and take land now used by wildlife for the survival of their people. Where will the animals go when the grass plains of Africa or the tropical rain forests of Brazil are ploughed for crops?

A winner in the battle against extinction, the Hawaiian goose, or nene, was saved because a remaining few were captured, bred in captivity, and returned to the wild.

By displaying fewer animals and exhibiting them better, and by breeding as many as possible, the National Zoo is becoming a modern-day Noah.

The swinhoe pheasant, which produces young regularly at the Zoo, is now considered extinct in the wild. This species formerly inhabited the island of Taiwan.

The Hawaiian goose, or nene, is the official bird of our fiftieth state. Half the size of the common Canada goose, the nene lives on dry, porous lava fields on the island of Hawaii, and neighboring Maui. It feeds on sparse vegetation and gets water from small, temporary rain pools. By 1949 a population that once numbered 25,000 had dropped to fewer than 50!

Hunted until 1907 and then killed off by introduced domestic animals, such as rats, dogs, and cats, the nene population was further reduced by habitat destruction until only a few individuals remained in the most inhospitable parts of the islands.

In 1949, Mr. Charles W. Schwartz, a wildlife biologist, suggested captive rearing to save the nene. The State of Hawaii established a captive population that year, and their efforts were joined in subsequent years by many other institutions and individuals. The breeding and the eventual release programs were successful. Today, over 1,500 birds have been released into the wild, and the future of the nene looks brighter than it has for over a century.

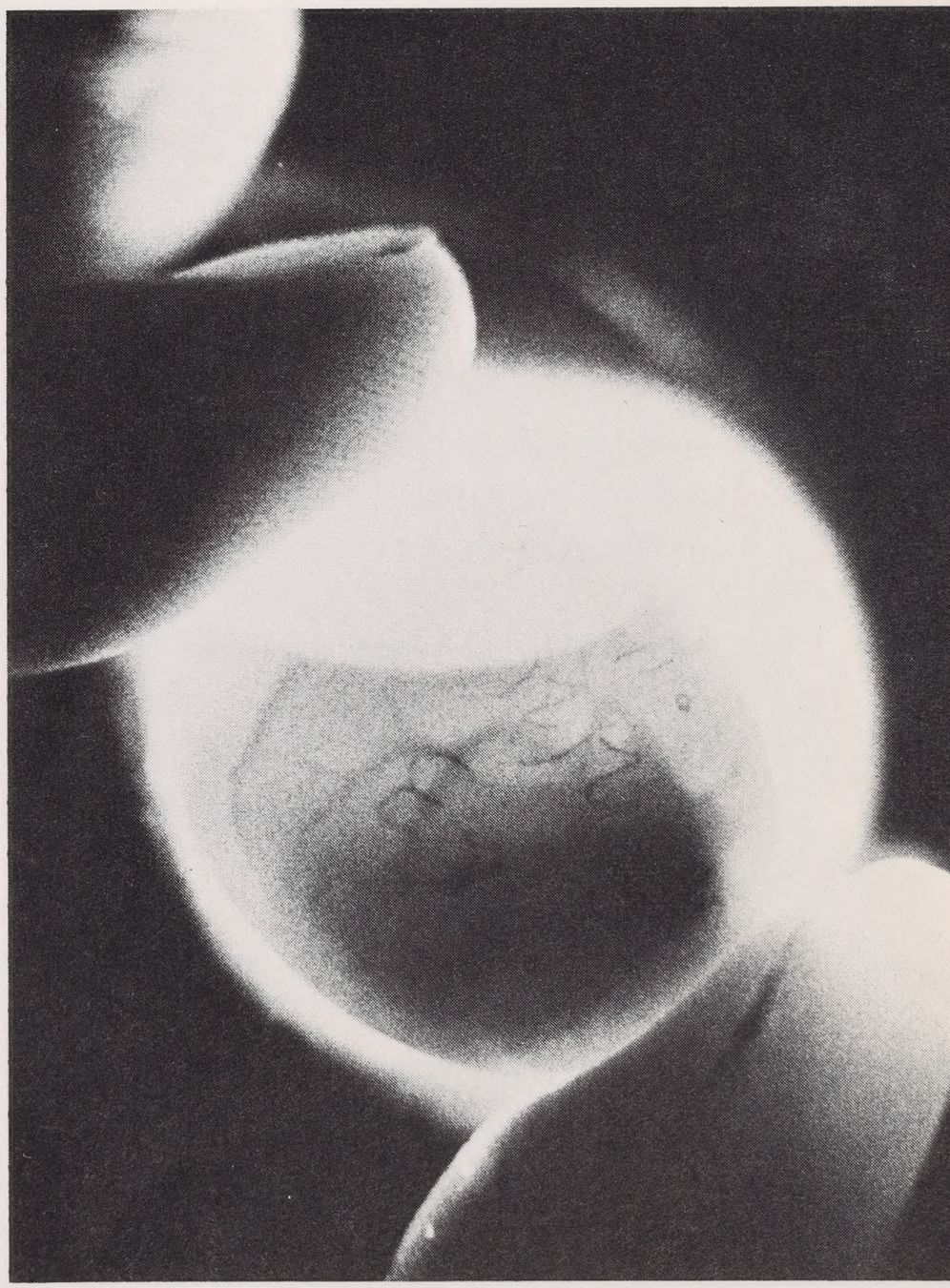
A nene breeding program began at the National Zoo in 1963. Since then over 50 young have been produced and sent to other institutions to insure the continued propagation and preservation of this beautiful species.

The Zoo's conservation efforts are not limited to severely threatened species. They apply to all animals. What factors must be considered to launch a bird breeding program?

Information on breeding biology, such as courtship, nest-building, egg-laying, incubation, and rearing of young, is crucial.

In many species, such as the cranes, males and females look alike. Many tests, such as blood and fecal analysis, have been developed to determine sex, but most are not reliable.

Extreme accuracy is obtained at the National Zoo by a simple surgical technique called "laparoscopy." The laparoscope is a thin metal tube packed with glass for magnification and designed so that a light is projected through a tube. By placing the tip of this instrument under the skin, the veterinarian can actually see the sex organs. Also, other organs, such as liver and spleen, can be examined for disease or malfunction.



The beginning of a bird is checked by a keeper who candles an egg to examine the developing embryo inside.

Courtship behavior varies between species. In the crowned crane, both male and female bob their heads up and down and lightly dance around with outstretched wings, often leaving the ground. Brilliantly colored areas of plumage, exposed areas of skin, and other physical adornments are used to attract a mate in many species.

Nests range from cavities in the ground to mammoth platform nests built up by generations of bald eagles. Quite often in captivity, the nest must actually be constructed by man to encourage the birds to breed.

The number of eggs produced by a female in one nesting is usually constant for each species. Pigeons lay only one or two eggs, while a quail produces up to 15.

Increased production is obtained at the Zoo by removing the eggs from some species for incubation and hatching. The Indian sarus crane normally produces two eggs and, consequently, two young per breeding season. By pulling the first two clutches for artificial incubation and leaving the last clutch with the parents, the Zoo produced six in 1977.

The Zoo's bald eagles produced a single chick in 1973 and have not produced young since, even though they have laid each year. In 1977, the first clutch, which consisted of two eggs, was removed and incubated artificially. Then the female laid a single egg, which she was allowed to keep. After incubation had been completed, both artificially and naturally, it was found that all three eggs were spoiled.

The egg, not the chicken, comes first in the Zoo's incubation unit. Here, hundreds of rare birds, from cranes to bald eagles, have begun life.

This year, the first two eggs will again be artificially incubated. One egg will be incubated at 100° F. just prior to being dipped into an antibiotic solution at 40° F. The warm egg will draw the cool antibiotic through the shell pores. The second egg will be directly injected with a different antibiotic. Hopefully the antibiotics will destroy the organisms causing decay, with the end result a baby eagle!

Research is also being conducted on artificial insemination, which has been used successfully in the domestic poultry business for a number of years. However, little work has been done on artificial insemination with exotic species, but the Zoo has already produced

one young ocellated turkey chick! It is conceivable that, in the future, where a shortage of males exists, semen collected from one male can be used to fertilize several females.

By emphasizing breeding, the National Zoo is quickly becoming a producer of wildlife. Eighty-five percent of all the new birds in 1977 were hatched at the Zoo.

Hopefully, the current effort on behalf of many individuals to conserve all living things will intensify and not die out. As John Perry, former deputy director at the National Zoo explained, "The world is our zoo—a zoo that must be well managed, its resources carefully husbanded, for these are the only resources it can ever have. We have appointed ourselves the keepers of this zoo, but we cannot live outside its gates. We are of it. Our lives are inextricably intertwined with the lives of all that live within. Their fate will be ours."

□

by Charles Pickett
Curator of Birds

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